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Air Pollution, Public Health, and Inflation

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Since the passage of the environmental legislation in the early 1970's, critics have attacked these laws as being unnecessary and for contributing significantly to the problem of inflation in the United States. This paper is an attempt to put the inflationary costs of air pollution into perspective by considering them in light of the cost, especially to public health, of *not* proceeding with pollution control. There is now a great deal of evidence that the concentration of certain pollutants in the air can contribute significantly to the incidence of respiratory and cardiovascular diseases and to certain forms of cancer. On the basis of the results of a recent study of the impacts of pollution control on inflation, the annual reduction in purchasing power of the average family is calculated to be $31 per family. To determine the average costs of air pollution on human health, research by Lave and Seskin is utilized. First, the implications of air pollution for mortality and morbidity rates are determined. Then, the reduction in direct health costs and indirect costs (lost productivity of workers) as a result of pollution abatement is estimated. These annual health costs from pollution total approximately $250 per family. The results suggest that the inflationary costs of air pollution control are more than offset by the damages to public health from unabated air pollution.

With the passage of the Clean Air Act Amendments of 1970, the Federal government committed the public and private sectors to billions of dollars in expenditure for pollution control. An estimated $4 billion was spent by private firms and utilities for air pollution control in 1976 (*1*). This large commitment of resources has prompted concern for the ultimate economic impact of environmental legislation on the American public. Critics have attacked this legislation as being unnecessary and as contributing dramatically to what many perceive as the major problem of the decade, inflation. Indeed, during the energy shortages of 1973-74 and subsequent price increases of energy, some members of the U.S. Congress were quick to call for a repeal of environmental legislation to keep prices from further escalating. Likewise, the automobile manufacturers have continually condemned environmental and safety regulations as unjustified and inflationary.

This paper will attempt to put the inflationary costs of pollution control into perspective by considering them in light of the costs, especially to public health, of *not* proceeding with pollution control. There is now a great deal of evidence that pollutants that exist in high concentrations in the ambient air can contribute significantly to the incidence of respiratory and cardiovascular diseases and to certain forms of cancer (*2*). Thus, a high cost is exacted, through an increase in health care costs and losses in worker productivity, by not reducing the existing air pollution levels. The first section contains a discussion of the extent of inflation as a result of pollution control expenditures necessitated by the Clean Air Act Amendments; the second section analyzes the health care costs, both direct and indirect, from stationary sources of air pollution and follows with a sensitivity analysis.

Inflation and Pollution Control

Pollution control expenditures, like most other business expenditures, contribute to higher prices. Since they raise the average cost of producing a given level of output, higher prices are necessitated to guarantee a given rate of return for the firm. †The actual price increases for the firms and the economy as a whole are dependent on the type of environmental legislation, the interpretation and compliance with the legislation, and the general state of the economy. For example, through specification of the

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†There is some pollution investment, however, which changes the production process or recycles wastes and results in higher productivity for the firm. In some cases, therefore, pollution control investment should lower prices. In addition, there is evidence that employment opportunities have and will continue to increase as a result of pollution investment (*3*).

stringency of the goals, the compliance dates and the type of policy (e.g., prohibition, regulation, taxes, subsidies, federal aid), the legislation, by itself, will influence the costs of controls and the effort required by the polluting firms. In addition, various conditions within the economy, such as the level of unemployment and inefficiency, the condition of the money and lending markets, the overall growth rate, the level of inflation, the industrial structure or degree of competition, the level of technology, and the attitudes and perceptions of business and consumer, will all determine the ease in which the legislative mandates can be incorporated into the economic system.

The inflationary impact of pollution control (both air and water) has been estimated by the use of various macroeconomic computer models. Chase Econometrics has projected an average annual increase in the consumer price index (CPI), a broad measure of prices throughout the economy, of 0.3-0.5% over the decade (*3*). It should be noted that this estimate is the result of air pollution abatement for both stationary and mobile sources. Further analysis showed that if the real (i.e., corrected for inflation) costs of abatement were 25% higher than expected, the price increment would be 25% higher, and the overall price increase would range from 0.375 to 0.625%.

To suggest the largest possible impact, consider the highest range of the latter estimate. Since the air pollution component is about 60% of air and water pollution expenditure, the best estimate for the average increase in inflation from air pollution control is $0.6 \times 0.625\% = 0.375\%$. To gain a sense of magnitude, the loss of purchasing power for the average urban resident can be determined. In 1977, the median family income for those living inside a metropolitan area was $17,371. An increase in the CPI of 0.375% would decrease annual purchasing power by approximately $65. It should be pointed out that this would be the cost to the consumer if the same bundle of goods was purchased regardless of the price increase. However, if consumers substitute cheaper goods, this figure may be an overestimate. On the other hand, if the price increase is uniform for an entire industry and substitute goods do not exist, this figure becomes more accurate. If the lower bound of the inflationary estimate of pollution control of 0.3% is used, the annual cost to the consumer would be $31.

Pollution and Public Health

A complete assessment of the economic effects of environmental legislation must include the impact of allowing pollution to continue unabated. These impacts, often hidden, unquantified, or just unmeasured, are frequently ignored in the inflation controversy. There is now a great deal of statistical evidence that pollution adversely affects public health, materials, vegetation, and property values (*2, 4, 5*). This section will concentrate on only the health cost to the public from air pollution.

Evidence of the impact of air pollution on public health is provided by a number of sources. According to a 1974 National Academy of Sciences report, most of the health damages are caused by two pollutants, sulfur dioxide and particulates (*6*). These two pollutants are produced from stationary sources, either as a result of industrial processes or from fuel combustion in power plants and industries. They are believed to be harmful to both the respiratory and circulatory system, and to cause a number of different forms of cancer (*2*). Shy (*7*) argued that in areas of the country where primary air quality standards are not being met, an additional 3% of the population runs the increased risk of asthma, an additional 10-15% of the exposed adult population will face a high risk of chronic bronchitis and emphysema, and 100% of the exposed children will have the increased risk of disturbed lung function. The research to date gives strong support to the contention that air pollution is a hazard to public health.

There are a number of ways in which air pollution can contribute to inflation (or a drop in disposable income) through its impact on public health. For example, worker productivity will be affected by pollution-related illness and death. Lack of aesthetics both inside and outside of the workplace can affect one's view of his/her labor. Purchases of preventive devices must increase with the knowledge of the damage that pollution may cause. Finally, direct expenditures on health care will increase for those impacted by pollution. Unfortunately, it is extremely difficult to estimate the inflationary impact of these effects. To do so, a researcher would have to calculate (a) the precise impact of air pollution on health for each pollutant for each disease; (b) the overall incidence of the disease; (c) the cost of treating the disease; and (d) the relationship between increased case load and change of case mix on inflation. Other techniques, however, can be utilized to approximate the impact of air pollution on health, although they are crude measures, at best.

To economists, the relevant question to ask to obtain a measure of value is "how much would people be willing to pay to obtain a lower incidence of disease or to prevent death?" Our society has shown that it is willing to spend vast sums of money for the treatment of specific diseases and for the provision of public health programs. The best estimate of this cost, and admittedly an undervaluation, is obtained by calculating the amount actually spent on health care (direct costs) that is related to pollution, and the value of earnings lost through illness or death (indirect costs) caused by pollution. These two measures will be used to give a rough estimate of the cost of pollution.

In fiscal year 1977 (ending September 1977), an estimated $162.6 billion was spent in the U.S. for health care (*8*). This represents a 12% increase in health care outlay over the previous 12 months raising the health care share of the Gross National Product (GNP) from 8.7% in 1976 to 8.8% in 1977. These costs include hospital care (40% of the total), physicians' and dentists' services, drug and drug sundries, nursing home care and other personal health care.

In order to estimate the share of these costs resulting from air pollution, the analysis of Lave and Seskin is employed (*2*). With a sample consisting of 117 metropolitan areas in the U.S., they have attempted to explain total mortality rates using a number of socioeconomic variables and measures of ambient air pollution. The results of their ordinary least-squares regression are:

$$\begin{aligned} MR = {} & 301.2 + \underset{(2.71)}{0.631}\ SUL + \underset{(2.67)}{0.452}\ PART \\ & + \underset{(1.71)}{0.089}\ DEN + \underset{(18.90)}{7.09}\ OLD + \underset{(4.32)}{0.422}\ NW \\ & - \underset{(0.02)}{0.002}\ POOR - \underset{(1.12)}{0.212}\ POP \\ & \qquad\qquad R^2 = 0.828 \end{aligned}$$

Here MR = total mortality per 100,000 population (mean = 912.6); SUL = smallest biweekly sulfate reading (in $\mu g/cm^3$; mean = 47.24); PART = arithmetic mean of biweekly suspended particulate readings (in $\mu g/cm^3$; mean = 118.145); DEN = metropolitan population density (per square mile × 0.1; mean = 69.96); OLD = percentage of metropolitan area population at least 65 years of age (× 10; mean = 83.87); NW = percentage of nonwhites in population (×10; mean = 124.8); POOR = percentage of metropolitan families with income below poverty level (× 10; mean = 181); POP = logarithm of population (× 100; mean = 565.72). The included variables explain 83% of the variation in the mortality rates. The *t* statistics are represented in parentheses below the estimated coefficients.

To obtain a unit-free measure of the percent change in the dependent variable (mortality) due to a percent change in the explanatory variable (air pollution), we can calculate the elasticity. Using the sample means, the elasticity of the mortality rates with respect to sulfur dioxide is 0.0327. This means that a 10% reduction in urban ambient sulfur dioxide levels will reduce mortality in metropolitan areas by 0.327%. Similarly, a 10% reduction in ambient particulate levels will reduce mortality by 0.0585%. Recall that these damages are primarily a result of emissions from stationary sources. Harrison (*9*) and National Academy of Sciences (*6*) provide estimates, not included here, of the cost of automobile emissions.

To estimate the public health costs of air pollution, three simplifying assumptions used in earlier research by Lave (*10*) and Small (*11*) are needed. In the last part of this paper, the sensitivity of the health cost estimates to some of these assumptions will be suggested. First, in an aggregate sense, morbidity is assumed to be affected by approximately the same proportion as mortality. Second, mortality and morbidity rates have proportional impacts on aggregate health costs. Unfortunately, there is little empirical verification for either of these assumptions. However, research by Liu and Yu (*5*) does show that the economic costs (direct and indirect) of stationary sources of air pollution are approximately the same for both morbidity and mortality. Their results suggest, for example, that a 10% reduction in both particulates and sulfur dioxide would result in a 19.4% decrease in the economic costs of mortality and a 18.2% decrease in morbidity costs. The third simplifying assumption is that a given percent change in emission will result in an equal percent improvement in pollution concentration levels. From these assumptions, one can state that an *X*% reduction in urban air pollution will result in a *Y*% reduction in mortality and morbidity rates and a *Z*% reduction in health costs.

The Environmental Protection Agency estimated that implementation of the Clean Air Act Amendments of 1970 would result in an 88% decrease in sulfur oxide emissions and a 58% decrease in particulate emissions from uncontrolled levels. From the results of the above regression, the reduction in morbidity and mortality from legislative compliance would be 6.27%. This figure is obtained by multiplying the pollution-mortality elasticity by the anticipated change in pollution for each pollutant: (58 × 0.0585) + (88 × 0.0327) = 6.27. Applying this reduction in death and disease to U.S. expenditure on health care in 1977, we may suggest a savings of $10.195 billion. The regression estimates, however, were for urban areas only. Since 73% of the population resided in a metropolitan area in 1977, the reduction in urban health costs would be 0.73 × $10.195 = $7.44 billion, or about $31 per family. Expressed in another way, the reduction in urban pollution levels associated with the Act would reduce morbidity/mortality by an estimated 0.73 × 6.27 = 4.58%.

To calculate the indirect cost to public health, measured in terms of lost earnings due to morbidity and early death, the work by Cooper and Rice can be utilized (*12*). Morbidity and mortality costs are obtained by applying average earnings by age and sex to the expected amount of lost work time. Since the cost of lost work time will occur over a number of years (from year of death to expected retirement), a discount rate is needed to determine the present value of the future losses that will occur.* Special consideration was given to determining a value for housework performed by unemployed wives, who comprise about half of the female population over 14 years of age. A market-value approach was used in which the value of a housewife's tasks equals the cost of replacing each task with person-hours from the existing labor force.

Using a 6% discount rate, the indirect costs of mortality and morbidity in 1972 were estimated to be \$99.7 billion. This figure should be adjusted to 1977 by considering the changes in real income and population. Real income in 1977 was approximately identical to that in 1972 so no adjustment is needed. Population grew at an annual rate of 0.6% between 1972 and 1977. Therefore, in 1977, indirect costs are $\$99.7 \times (1.006)^5 = \$102.7$ billion in 1972 dollars or \$148.8 billion in 1977 dollars. If, as estimated above. 4.5% of the health costs are necessitated by urban air pollution, the indirect public health costs of pollution are \$6.82 billion or \$120 per family. Total direct and indirect health costs from stationary sources of air pollution are \$251 per family. This can be compared to the most liberal (largest) estimated impact of inflation from pollution control on disposable income of \$65 per family.

Another way of considering the magnitude of the different impacts is to determine the values of the parameters that will equate the two costs. For example, if the inflationary costs of air pollution control are \$65 per family, as estimated above, the air pollution-induced health expenditures would have to be but 1.13% of total health costs (versus the estimated 4.58%) for public health and abatement costs to be equal. On the other hand, if the pollution costs are assumed to be \$251 per family, the annual increment to the CPI due to abatement expenditures would have to be 1.47% (versus the estimated 0.375) for the costs to be equal. This is about four times the anticipated inflationary impact.

Finally, to provide the most conservative estimate of the health costs of air pollution, let us reconsider the earlier assumptions. Assume, first, that the true impact of air pollution on morbidity and mortality is half of the estimate suggested by the regression analysis above. The estimated impact on urban mortality from air pollution falls from 4.58% to 2.29%. Next, assume that the relationship between the prevention of mortality and morbidity and subsequent health costs is less than proportional. Specifically, an $X\%$ decrease in mortality and morbidity will result in only a $0.75X\%$ decrease in health costs. This may result because of the large fixed costs and amortization of health care facilities. The ultimate cost of air pollution to public health under these assumptions is \$50 per family. This is still almost double the anticipated cost of inflation. In addition, true estimates of pollution cost should include the damages to property, aesthetics and vegetation.

Obviously, these health damage estimates provided here are only suggestive and should be interpreted with caution. They are presented only to give one a sense of the magnitude of the health costs of air pollution typically neglected in the criticism of environmental legislation. Depending on factors such as income, residential location, and consumption patterns, different groups may bear varying degrees of health costs or costs from abatement generated inflation. There is little doubt that there is a cost involved in providing clean air in our urban areas. The tentative results of this research, however, suggest that these costs may be more than offset by the damages to public health from air pollution if we fail to provide any pollution control.

*A simple arithmetic sum of the earnings over all of the working years will overstate the present value of the earnings. A dollar earned five years from now has a value of less than a dollar today, even with zero inflation, because of the ability to earn interest.

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